MEDOW Training Event

01/07/2014 **ENERCON Manufacturing Unit**

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ENERCON is a German wind turbine company that was founded in 1984. They have two factories in the north of Portugal, one in Viana do Castelo and the other nearby Lanheses. Both factories started in 2007 and they manufacture most of the elements of the E-92 wind turbine model that ENERCON offers as part of their products. They started manufacturing the E-82 model, the predecessor of E-92, but currently they only are focused on the production of E-92, which has similar specifications but it improves the efficiency around 10-15%.

Blades/Tower plant

The first place that we visited was the plant located in Viana do Castelo, which is responsible for making the blades and the concrete towers. It is easy to recognize the factory because there is an E-82 wind turbine prototype that can be seen from a long distance. There was not allowed to take pictures of the facilities but we could follow all the manufacturing process in detail.

Figure 1: Entrance of the ENERCON plant in Viana do Castelo

The blade section was the first part of the plant that we visited. There were different stainless steel moulds and in each of them the blades were manufactured following in total 4 steps. The blades are basically hollow structures with an outer shell made of fiberglass epoxy resin and balsa wood. They also have a folded tip that reduces the noise emission and the aerodynamic turbulence, improving their efficiency.

The workers have to lay manually several fiberglass fabrics one by one to make one half of the blade. Then, the epoxy resin is dropped to glue all the layers whereas vacuum is made from the bottom of the moulds to ensure that the resin fills the entire half blade. Finally, both parts are joined and robot cranes lift them to an oven to be baked. Once the hollow structure is obtained, the necessary cylinders for screwing the nacelle structure are set and some other additional elements can be included, for example to improve the aerodynamic response of the blades. At the end, the blades are sanded and painted and they are transported outside the building waiting for a future delivering. Following this process the factory is able to produce in total 21 blades per week.

In the concrete tower section the manufacturing process of the different tower parts of the wind turbines was shown. In total the towers are made of 20 reinforced concrete segments and 2 more of steel. For each cylinder the steel bars are set making a net along with several electrical cables. Then, these structures are filled with concrete by the help of a mould. Once the segments are dried they are sanded and painted. The assembly of the segments is made with a crane in the place where the wind turbine will be set up.

Generator/Mechatronic plant

During the guided tour to ENERCON's generator production and mechatronic factory buildings in Lanheses, we were able to know and understand more about the production processes and ENERCON's special turbine concept. The industrial unit is divided into the following areas:

- Production area, processing area to manufacture the generators, and that is the nave of the building;
- Administrative area, which includes refectory, cloak-room, toilets, offices and meeting rooms and other essential spaces for the proper functioning of the building.

The Generator/Mechatronic plant structure is as follows:

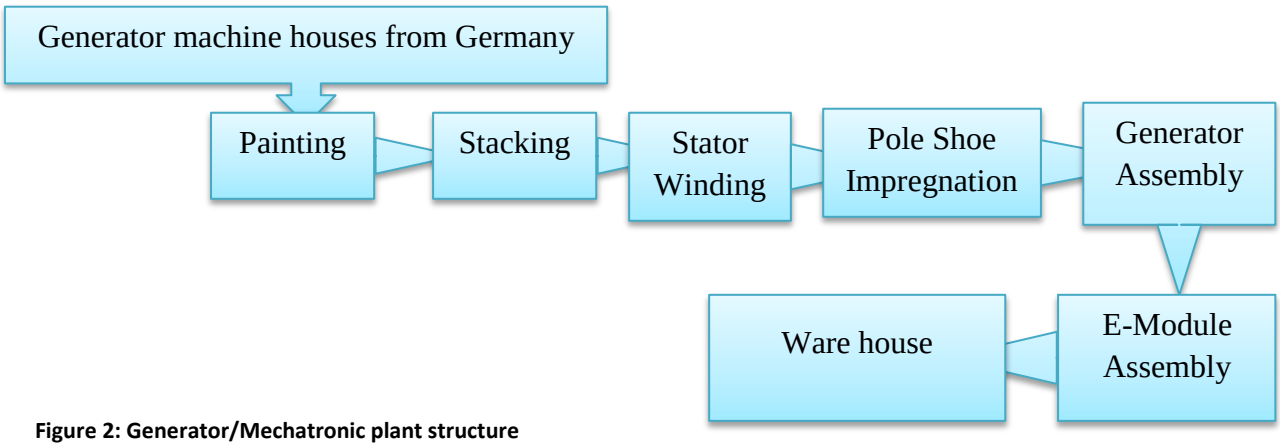

Figure 2: Generator/Mechatronic plant structure

The generator machine houses were supplied by the production facilities in Aurich, Germany. These again were painted and stacked at the facility in Portugal, and then the stator windings

are provided with 72 rotor poles along the circumference of the stator. The distance between the rotor poles and the stator is 0.5mm. The rotor windings are made on the rotor blades, whose shape is shown in Figure 3. The reason for the special shape in the middle of the blade is to avoid noise and it will also help in increasing the efficiency. The next stop was at the impregnation stage where the pre-heating of the rotor/stator is taking place. The generator is then placed into the resin tank and preheated there; the resin curve is used to determine the heating temperature. The generator is then transferred to the powder coating tank. The final stage is the installation of the E-module, which consists of the circuit breakers, unit transformer, filters, converters and the rectifiers with necessary control systems. Finally, the finished generator module is sent to the warehouse

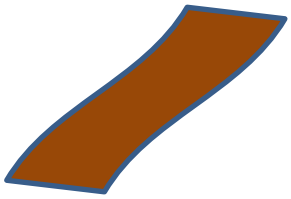

Figure 3: The rotor blade structure

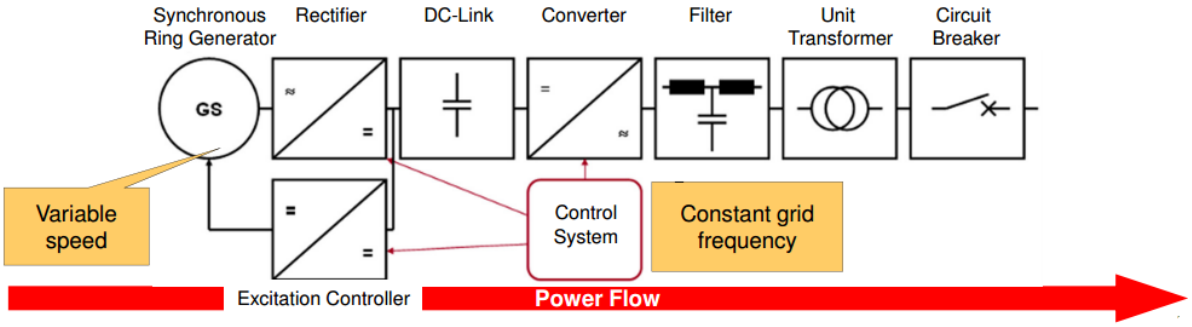

Figure 4: The rotor assembly schematic [1]

Rotor sail ship *E-Ship 1*

Besides the two naves, ENERCON has developed a special type of vessel called *E-Ship 1*. Since its maiden voyage in 2010, the *E-Ship 1*, designed for transporting ENERCON wind turbine components, has covered more than 170,000 sea miles. Using the Magnus Effect, the four innovative Flettner rotors provide the main engine with additional drive and account for more than 15 percent of the savings. The rotor sails on the ENERCON-developed *E-Ship* 1»allow operational fuel savings of up to 25% compared to same-sized conventional freight vessels.

At the end of the visit, a video explaining the mounting process of the E-82 prototype set up in Viana do Castelo was shown to understand how the final wind turbines have to be assembled and the time that they need.

This visit was quite useful for us to deeply understand the wind turbine structure and the technology systems. The field experience will be helpful for our future research in modelling and simulating the wind turbines and structures. It also gave us an insight about the real world materials used for turbine manufacturing, especially the rotor blades, generators, converters and the installations, each of which will be used for our research in developing offshore wind farm network

Reference:

[1] http://www.stalflex.is/skjalasafn/900_7500/ENERCON_HS%20Orka_Gentsch_pdfx.pdf [Accessed: 27-July-2014].